REMARKS

Review and reconsideration on the merits are requested.

Formalities

Applicant appreciates the Examiner accepting the drawings filed April 12, 2004, acknowledging receipt of a certified copy of the single priority document and returning initialed PTO/SB/08 filed April 12, 2004.

Applicant now turns to the Action.

Election/Restrictions

Applicant affirms the election of Group I, claims 1-2 and 8.

Specification

Applicant responds to the objection to the specification and the use of "surly" at page 2, line 28, by canceling "surly".

Withdrawal of the objection is requested.

The Prior Art:

U.S. 5,810,925 Tadatomo et al. (Tadatomo);

U.S. 6,040,588 Koide et al. (Koide '588);

U.S. 6,420,733 Koide et al. (Koide '733);

U.S. 6,407,409 Cho et al. (Cho).

The Rejections

All rejections are under 35 U.S.C. § 103(a).

Claims 1, 2 and 8, all pending claims, were rejected as unpatentable over Tadatomo, Koide '588, Koide '733 or Cho.

The Examiner's position is set forth in the Action and will not be repeated here except as necessary to an understanding of Applicant's traversal which is now presented.

Traversal

Claim 1 of the present application calls for:

> "A self-supported nitride semiconductor substrate having an X-ray diffraction half width of 500 seconds or less in at least one of a {20-24} diffraction plane and a {11-24} diffraction plane, and a diameter of 10 mm or more."

Major distinguishing features of the claimed invention are the self-supported nitride semiconductor substrate which has an X-ray diffraction half width in at least one of a {20-24} diffraction plane and a {11-24} diffraction plane.

The following disclosure occurs at page 1/2 of the present specification and nicely sets the background of the present invention.

It is generally difficult to prepare a self-supporting nitride semiconductor substrate by crystal growth of the nitride semiconductor substrate in bulk form from a melt thereof. As a consequence, a self-supporting nitride semiconductor substrate is usually obtained by growing a nitride semiconductor layer on a different base substrate, such as sapphire or gallium arsenide, whereafter the nitride semiconductor layer is removed from the base substrate to leave only the nitride semiconductor layer.

The formation of a nitride semiconductor layer on a different base substrate such as sapphire, etc., with large lattice mismatch is usually achieved not by epitaxial growth of a nitride

semiconductor coherent with the lattice of the base substrate, but by growing crystal nuclei at many points on the base substrate to such an extent that they become integrated to yield a continuous film.

A film obtained by "integrating" such nitride semiconductor crystals does not have a lattice plane completely parallel to that of the substrate (is not a completely flat surface), which results in slight deviations of crystal orientations therebetween. This crystal structure is called a mosaic structure. The deviations are roughly divided in two groups: one is deviation in a crystal-growth direction, which is called "tilt", and the other is deviation caused by the rotation of crystals in a plane, which is called "twist."

It is common to use the diffraction half width determined by X-ray diffraction as a method for evaluating crystal quality such as the deviations of crystal orientations, etc. The X-ray diffraction method serves to measure a diffraction strength in the reciprocal lattice spacing, thereby making it possible to measure not only the distance of crystal faces but also "tilt" and "twist" in the crystalline mosaic structure. For instance, in a film grown in the c-axis, the width of the X-ray diffraction half width from a {0002} symmetric diffraction plane, etc., shows distribution of "tilt", and the width of the half width of the X-ray diffraction half width from a {10-10} plane diffraction shows the distribution of "twist".

The quality of nitride semiconductor substrates has conventionally been evaluated by the half width of the X-ray rocking curve in the {0002} diffraction plane, etc. However, the inventors discovered that even if the half width of the X-ray rocking curve of the {0002} symmetric diffraction plane, etc., is narrow, that is, the distribution of "tilt" is very small,

nonetheless the distribution of the "twist" can be very large, resulting in the emission properties and the electrical properties of the crystals being significantly deteriorated.

It has now been discovered that crystals having a large half width distribution of "twist", though they may have a very narrow width of their X-ray diffraction half width from a {0002} symmetric diffraction plane, show a tendency to have significantly poor photoluminescence strength and significantly high remaining dopant concentration, resulting in an increase in the dislocation density thereof. Nitride semiconductor substrates should be formed of crystals having a very narrow half width distribution both with respect to "tilt" and "twist".

When the X-ray diffraction half widths of the {10-10} diffraction plane are measured to obtain the "twist" distribution of crystals, it is necessary to apply the X-ray injection close to the sample surface of a film made of nitride semiconductor crystals grown in the c-axis direction, which will make the peak strength poor and make the noise high, which will in turn cause such problems that the measurement error of the peak width for evaluating the quality of the crystals becomes large.

To solve such a problem, a nitride semiconductor substrate in the present invention is specified by a value of X-ray diffraction half width in a {20-24} diffraction plane or a {11-24} diffraction plane which includes both information on crystals in the c-axis direction ("tilt") and in the a-axis direction ("twist") and will result in a strong peak strength of photoluminescence and a minimum measurement error of the peak width.

In contrast, Tadatomo teaches a GaN single crystal having a full width at half-maximum of the double-crystal X-ray rocking curve of 5-250 sec and a thickness of not less than 80 μm, a

method for producing such a GaN single crystal having superior quality and sufficient thickness to permit its use as a substrate and a semiconductor light emitting element having high luminance and high reliability, comprising, as a substrate, the GaN single crystal having superior quality and/or sufficient thickness to permit use as a substrate (see Abstract; column 2, lines 28-39 of Tadatomo.

Tadatomo discloses at column 7, lines 3-7:

> "The measurement was done with respect to the diffraction peak of GaN (0002) at a step interval of measurement of 0.0020°."

This means that Tadatomo carried out the measurement of an X-ray diffraction half width in a (0002) plane as mentioned above, which is completely different from the measurement of the claimed invention.

Accordingly, one of ordinary skill in the art referring to Tadatomo would not be motivated to reach the invention of claim 1 as there is no suggestion in Tadatomo of the use of the X-ray diffraction half width as claimed in claim 1 for any purpose

With respect to claims 2 and 8, Applicant relies upon their arguments for patentability regarding claim 1 to establish unobviousness over Tadatomo, noting that claim 8 calls for a light emitting nitride semiconductor device comprising an epitaxial nitride layer with a light-emitting device structure formed on a self-supported nitride semiconductor substrate of claim 1.

Applicant treats the rejections over Koide '588, Koide '733 and Cho together.

None of these references teach or suggest the distinguishing features of claim 1 above discussed. In Applicant's view, such prior art is distinguished on this record for the same reasons as Tadatomo.

Accordingly, Applicant submits that the obviousness rejection over these references is improper and include request for withdrawal of the rejections.

With respect to claim 2, Applicant's will rely upon the arguments regarding claim 1, and with respect to claim 8, Applicant's rely upon the position as set forth regarding Tadatomo.

Withdrawal is requested.

Inherency

It seems quite clear that the Examiner is relying upon inherency to support the rejection of the claims. The Examiner's reasoning is basically as follows.

Regarding Tadatomo:

> "Would be inherent given the materials disclosed, the quality of the substrate and the luminescence achieved."

Regarding Koide '588:

> "Would be inherent given the materials disclosed, the quality of the substrate and the carrier density of less than 1×10^{20} cm^{-3}."

Regarding Koide '733:

> "Would be inherent given the materials disclosed, the quality of the substrate and the carrier density of less than 1×10^{20} cm^{-3}."

Regarding Cho:

> "Would be inherent given the materials disclosed, the quality of the substrate [the] luminescence and the carrier density of less than 1×10^{20} cm^{-3}."

What the Examiner has failed to do is to establish any correlation between the materials disclosed, the quality of the substrate, the carrier density or luminescence and the resulting

product exhibiting an X-ray diffraction half width in at least one of a {20-24} diffraction plane and a {11-24} diffraction plane.

The general law in this area is that for a finding of inherency to ensue, the Examiner must provide basis in fact and/or technical reasoning to reasonably support the determination that an allegedly inherent result *necessarily* flows from the teachings of the applied prior art. *Ex parte Levy*, 17 USPQ2d 1461 (Bd. Pat. App. & Int. 1990). Further, it is well established in the inherency area that the inherent result must necessarily occur, not just occur by chance. *Levy, supra.*

In rebuttal of the Examiner's inherency position, the Examiner is referred to Table 1.

To quote the specification at the bottom of page 10:

"Table 1 shows the relation between an X-ray diffraction half width of a (0002) plane of each self-supported GaN substrates of Samples 1 to 9 and the emission power of LED produced by using each self-supported GaN substrate. It is clear from Table 1 that even LEDs produced by using GaN substrates with a small X-ray diffraction half width of a (0002) plane do not necessarily provide high emission power."

Further in rebuttal of the Examiner's position, the Examiner's attention is directed to Table 3 at pages 19/20 of the specification and the discussion at page 20 which is as follows:

"With respect to each LED device sample of 1 to 9, the relations between the X-ray diffraction half widths of a (20-24) plane and a (11-24) plane and the emission power are shown in Figs. 3 and 4. It is clear from Figs. 3 and 4 that the LED devices of Samples 1 to 7, in which the X-ray diffraction half widths of a (20-24) plane and a (11-24) plane of the self-supported GaN substrate had 500 seconds or less, had emission power more than two times that of the LED devices of Samples 8, 9, in which the corresponding X-ray diffraction half widths had more than 500 seconds. The driving voltage of the LED device was high when the self-supported GaN substrate had an X-ray diffraction width of more than 500 seconds in a (20-24) plane and a (11-24) plane."

Accordingly, Applicant respectfully submits that assuming *arguendo* the Examiner has attempted to shift the burden of proof on inherency, the proofs in the present specification establish that the inherent result that the Examiner urges does not invariably happen. See, in this regard, *Gubelmann v. Gang,* 408 F.2d 758, 766, 161 USPQ 216, 222 (CCPA 1969).

Withdrawal of the rejections and allowance is requested.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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